A Comparison of State and EPA Sulfur Dioxide Emission Rates Used in Recent Air Quality Modeling

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The Department has compiled the emission rates used in air quality modeling of source inventories of emitted sulfur dioxide. The modeling was conducted by the State and by EPA for purposes of illustrating deterioration of ambient sulfur dioxide within PSD Class I areas in North Dakota. The emission rate data were extracted from the following reports.

- "Prevention of Significant Deterioration, Sulfur Dioxide, Final Baseline Emission Rates." May 2003. North Dakota Department of Health.

- "Calpuff Analysis of Current PSD Class I Increment Consumption in North Dakota and Eastern Montana Using Actual Annual Average SO2 Emission Rates." May 2003. North Dakota Department of Health.

- "Dispersion Modeling Analysis of PSD Class I Increment Consumption in North Dakota and Eastern Montana." May 2003. United States Environmental Protection Agency.

EPA's modeling of North Dakota sulfur dioxide sources is the first known instance of such EPA PSD increment-assessment modeling in the history of the Department's PSD program, which dates to 1975.

Sulfur dioxide emission rates were extracted from these documents for PSD baseline-period and for current inventories of major sources that emit sulfur dioxide and are located within North Dakota and eastern Montana. Emission rates for major sources operating during the baseline period are provided in the first table attached. Emission rates for major sources operating during the current period are provided in the second table attached. Finally, the PSD increment-affecting sulfur dioxide emission rates are illustrated in the third table attached.

Upon examination of the rate data, sulfur dioxide emission rates of oil refineries and natural gas processing plants used by respective agencies are similar. The rates of these sources are a small fraction of total emitted sulfur dioxide.

Two natural gas processing plants recently discontinued operation of sulfur recovery units and began subsurface injection of sour gas. EPA included sulfur dioxide emissions of these sources with its current-period inventory.

The rates used by respective agencies for coal-fired power plants vary widely from source to source. While the Department and EPA used rates of emitted sulfur dioxide derived from data in source annual emission inventory reports and from data obtained by stack monitoring (CEM), differences in baseline-period and current-period rates are significant. The differences in the rates for these sources apparently are due to the following:

- Interpretation and application of the definition for "actual emissions", which is provided by rule and discussed in EPA regulation (rule preamble) and guidance.

- Interpretation and application of the two-year period representing "normal source operation" as used in the definition for "actual emissions" and discussed by EPA regulation (rule preamble) and guidance.

    - The Department and EPA used the same two-year period for the current-period inventory of coal-fired sources emitting sulfur dioxide.

    - The Department and EPA did not use the same two-year period for some coal-fired sources operating at PSD baseline. For these sources, the State chose an alternate two-year period that included one or both years after the PSD minor source baseline date. EPA confined normal source operation of all sources to the two years proceeding the PSD minor source baseline date, which is 19 December 1977 for western North Dakota.

- Calculation of the representative emission rate during normal source operations.

    - The Department used an annual average rate during source operation. EPA used the 90th percentile of 24-hour block averaged hourly CEM data or a facsimile of the 90th percentile.

    - The Department calibrated EPA's AP-42 formulae using current-period CEM data and annual operating data. It then applied the calibrated formulae to calculation of baseline-period emission rates using operating data from baseline-period source emission inventory reports. EPA applied its formulae, without source CEM calibration, to the data in baseline-period source emission inventory reports when calculating baseline-period emission rates.

The outcome of these differences in calculation of major-source sulfur dioxide emission rates is that EPA's baseline-period rates for coal-fired power plants are generally lower than the Department's rates (first table) and EPA's current-period rates are generally higher than the Department's rates (second table). EPA's calculated rates result in greater PSD increment-affecting emissions compared to the Department's rates (third table).

In summary, the Department adhered to rule and regulation when calculating major source emission rates, and it disclosed and explained reasons for departure from EPA's historic NSR and AP-42 guidance documents. EPA's choices for emission rates, and its choice to conduct its own modeling, appear to set and impose boundaries of discretion in calculating those rates – in spite of provisions of rule, regulation, source operating history, and other factors such as demonstrated, or lack thereof, model performance in North Dakota.

Supplemental supporting information.

40 CFR 51.166(b)(21) defines actual emissions as the rate of emissions during a 2-year period

> "which precedes the particular date and which is representative of normal operations. *The reviewing authority may allow the use of a different time period upon a determination that it is more representative of normal sound operation.* (Emphasis added)

N.D. Admin. Code § 33-15-01-01(1)(a)(1) provides:

> In general, actual emissions as of a particular date must equal the average rate, in tons per year, at which the unit actually emitted the contaminant during a two-year period *which precedes the particular date and which is representative of normal source operation. The department may allow the use of a different time period upon a determination that it is more representative of normal source operation.* Actual emissions must be calculated using the unit's actual operating hours, production rates, and types of materials processed, stored, or combusted during the selected time period.

The 1980 PSD preamble interpreting this rule stated that:

> "If a source can demonstrate that its operation after the baseline date is more representative of normal source operation than its operation preceding the baseline, the definition of actual emissions allows the reviewing authority to use the more representative period to calculate the source's actual emissions contribution to the baseline concentration. *EPA thus believes that sufficient flexibility exists within the definition of actual emission to allow any reasonably anticipated increases or decreases genuinely reflecting normal source operation to be included in the baseline concentration."*

(Emphasis added) 45 Fed. Reg. 52714-15 (Aug. 7, 1980).

PSD baseline-period emission rates from May-2003 reports.

Source	Unit
Beulah Power Plant	1 & 2
	3, 4 & 5
Neal Station	1 & 2
R.M. Heskett Station	1
	2
Leland Olds Station	1
	2
M.R. Young Station	1
	2
Stanton Station	1
Royal Oak Briquetting Plant	Boilers 1, 2 & 3
	Carbonizer Furnaces
Tioga Gas Plant	SRU Incinerator
Lignite Gas Plant	SRU Incinerator
Williston Refinery	All units
	Preflash Heater
	Crude Heater
	Thermal Cracking Heater
	Charge Heater
	Reformer Heater
	Boiler 1
	Boiler 2
	Boiler 3
Mandan Refinery	Boilers 1, 2 & 3
	Crude Furnace
	FCCU
	Alkylation Unit
	Furnaces
	Uitraformer Furnaces

STATE

Baseline Period	Emission Rate		
76 - 77	an.ave.	lb/op-hr	137.1
76 - 77	an.ave.	lb/op-hr	224.6
76 - 77	an.ave.	lb/op-hr	354.6
76 - 77	an.ave.	lb/op-hr	466.0
76 - 77	an.ave.	lb/op-hr	1,087.2
76 - 77	an.ave.	lb/op-hr	3,990.1
77 - 78	an.ave.	lb/op-hr	8,106.2
78 - 79	an.ave.	lb/op-hr	4,959.9
79 - 80	an.ave.	lb/op-hr	4,905.6
78 - 79	an.ave.	lb/op-hr	2,487.5
78 - 79	an.ave.	lb/op-hr	172.1
78 - 79	an.ave.	lb/op-hr	1,542.0
77	an.ave.	lb/op-hr	1,107.1
76 - 77	an.ave.	lb/op-hr	285.8
76	an.ave.	lb/op-hr	51.7
76	an.ave.	lb/op-hr	7.1
76	an.ave.	lb/op-hr	7.7
76	an.ave.	lb/op-hr	0.3
76	an.ave.	lb/op-hr	0.1
76	an.ave.	lb/op-hr	0.5
76	an.ave.	lb/op-hr	10.5
76	an.ave.	lb/op-hr	10.5
76	an.ave.	lb/op-hr	15.0
76 - 77	an.ave.	lb/op-hr	622.6
76 - 77	an.ave.	lb/op-hr	550.1
76 - 77	an.ave.	lb/op-hr	1,135.8
76 - 77	an.ave.	lb/op-hr	160.3
76 - 77	an.ave.	lb/op-hr	15.3
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EPA

Baseline Period	Emission Rate		
76 - 77	an.ave.	lb/hr	621
76 - 77	an.ave.	lb/hr	--
76 - 77	an.ave.	lb/hr	297
76 - 77	~ 90th%	lb/hr	589
76 - 77	~ 90th%	lb/hr	1,625
76 - 77	~ 90th%	lb/hr	2,714
76 - 77	~ 90th%	lb/hr	4,185
76 - 77	~ 90th%	lb/hr	3,972
76 - 77	~ 90th%	lb/hr	5,635
76 - 77	~ 90th%	lb/hr	2,359
76 - 77	an.ave.	lb/hr	545
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77	an.ave.	lb/hr	1,107
76 - 77	an.ave.	lb/hr	286
76	an.ave.	lb/hr	45
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76	an.ave.	lb/hr	512
76	an.ave.	lb/hr	550
76	an.ave.	lb/hr	1,136
76	an.ave.	lb/hr	160
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76	an.ave.	lb/hr	14

an.ave. = annual average

lb/op-hr = pounds per operating hour

90th% = 90th percentile of 24-hour block-averages

additional difference not shown -- application of AP-42 for power plant baseline-period emissions

PSD current-period emission rates from May-2003 reports.

Source	Unit	STATE Current Period	STATE Emission Rate			EPA Current Period	EPA Emission Rate		
Coal Creek Station	1	00 - 01	an.ave	lb/op-hr	3,368.3	00-01	90th%	lb/hr	4,269
	2	00 - 01	an.ave	lb/op-hr	2,973.0	00-01	90th%	lb.hr	3,429
Antelop Valley Station	1	00 - 01	an.ave	lb/op-hr	1,590.5	00-01	90th%	lb/hr	3,440
	2	00 - 01	an.ave	lb/op-hr	1,496.0	00-01	90th%	lb/hr	3,440
Coyote Station	1	00 - 01	an.ave	lb/op-hr	3,955.6	00-01	90th%	lb/hr	4,755
PPL Corp Colstrip	3	00 - 01	an.ave	lb/op-hr	742.9	00-01	90th%	lb/hr	655
	4	00 - 01	an.ave	lb/op-hr	719.0	00-01	90th%	lb/hr	597
CELP Colstrip		00 - 01	an.ave	lb/op-hr	419.8	00-01	90th%	lb/hr	420
R.M. Heskett Station	1	00 - 01	an.ave.	lb/op-hr	246.8	00-01	90th%	lb/hr	342
	2	00 - 01	an.ave.	lb/op-hr	612.7	00-01	90th%	lb/hr	849
Leland Olds Station	1	00 - 01	an.ave.	lb/op-hr	4,179.4	00-01	90th%	lb/hr	5,085
	2	00 - 01	an.ave.	lb/op-hr	8,565.9	00-01	90th%	lb/hr	10,354
M.R. Young Station	1	00 - 01	an.ave.	lb/op-hr	5,161.1	00-01	90th%	lb/hr	6,087
	2	00 - 01	an.ave.	lb/op-hr	4,353.2	00-01	90th%	lb/hr	5,749
Stanton Station	1 & 10	00 - 01	an.ave.	lb/op-hr	2,389.7	00-01	90th%	lb/hr	2,985
Tioga Gas Plant	SRU Incinerator	00 - 01	an.ave.	lb/op-hr	296.0	00-01	an.ave.	lb/hr	305
Lignite Gas Plant	SRU Incinerator				0 fn1	00-01	an.ave.	lb/hr	120
Grasslands Gas Plant	SRU Incinerator				0 fn1	00-01	an.ave.	lb/hr	263
Little Knife Gas Plant	SRU Incinerator	00 - 01	an.ave.	lb/op-hr	N/A	00-01	an.ave.	lb/hr	84
Great Plains Syfuels	Main stack	00 - 01	an.ave.	lb/op-hr	N/A	00-01	an.ave.	lb/hr	1,051
	Bypass stack	00 - 01	an.ave.	lb/op-hr	N/A	00-01	an.ave.	lb/hr	855
	Start-up flare	00 - 01	an.ave.	lb/op-hr	N/A	00-01	an.ave.	lb/hr	396
	Main flare	00 - 01	an.ave.	lb/op-hr	N/A	00-01	an.ave.	lb/hr	178
	Back-up flare	00 - 01	an.ave.	lb/op-hr	N/A	00-01	an.ave.	lb/hr	124
Mandan Refinery	Boilers 1, 2 & 3	00 - 01	an.ave.	lb/op-hr	141.3	00-01	an.ave.	lb/hr	86
	Crude Furnace	00 - 01	an.ave.	lb/op-hr	0.0	00-01	an.ave.	lb/hr	45
	FCCU	00 - 01	an.ave.	lb/op-hr	1,057.1	00-01	an.ave.	lb/hr	1,006
	Alkylation Unit	00 - 01	an.ave.	lb/op-hr	7.1	00-01	an.ave.	lb/hr	8
	SRU Incinerator	00 - 01	an.ave.	lb/op-hr	42.1	00-01	an.ave.	lb/hr	49
	Ultraformer Furnaces	00 - 01	an.ave.	lb/op-hr	15.1	00-01	an.ave.	lb/hr	16

fn1 = injecting sour gas

N/A = FLM certified emissions as causing no-adverse impacts on AQRVs

Current-period emission rate minus current-period emission rate.

Source	Unit	STATE Baseline	STATE Current	STATE Difference	EPA Baseline	EPA Current	EPA Difference
Coal Creek Station	1		3,368.3	3,368		4,269.0	4,269
	2		2,973.0	2,973		3,429.0	3,429
Antelop Valley Station	1		1,590.5	1,590		3,440.0	3,440
	2		1,496.0	1,496		3,440.0	3,440
Coyote Station	1		3,955.6	3,956		4,755.0	4,755
PPL Corp Colstrip	3		742.9	743		655.0	655
	4		719.0	719		597.0	597
CELP Colstrip			419.8	420		420.0	420
Beulah Power Plant	1 & 2	137.1		-137	621.0		-621
	3, 4 & 5	224.6		-225			0
Neal Station	1 & 2	354.6		-355	297.0		-297
R.M. Heskett Station	1	446.0	246.8	-199	589.0	342.0	-247
	2	1,087.2	612.7	-475	1,625.0	849.0	-776
Leland Olds Station	1	3,990.1	4,179.4	189	2,714.0	5,085.0	2,371
	2	8,106.2	8,565.9	460	4,185.0	10,354.0	6,169
M.R. Young Station	1	4,959.2	5,161.1	202	3,972.0	6,087.0	2,115
	2	4,905.6	4,353.2	-552	5,635.0	5,749.0	114
Stanton Station	1 & 10	2,487.5	2,389.7	-98	2,359.0	2,985.0	626
Royal Oak Briquetting Plant	Boilers 1, 2 & 3	172.1		-172	545.0		-545
	Carbonizer Furnaces	1,542.0		-1,542			
Grasslands Gas Plant	SRU Incinerator		fn1	0		263.0	263
Little Knife Gas Plant	SRU Incinerator		N/A			84.0	84
Tioga Gas Plant	SRU Incinerator	1,107.1	296.0	-811	1,107.0	305.0	-802
Lignite Gas Plant	SRU Incinerator	285.8	fn1	-286	286.0	120.0	-166
Great Plains Synfuels	All units		N/A			2,604.0	2,604
Williston Refinery	All units	51.7		-52	45.0		-45
Mandan Refinery	All units	2,484.1	1,262.7	-1,221	2,372.0	1,210.0	-1,162
Sum				9,992			30,690